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Digital Area for Networking  
Teachers and Educators



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# Capital Budgeting

Introduction



# Describe the capital budgeting process and distinguish among the various categories of capital projects

**Capital budgeting** refers to the process of planning expenditures on assets whose cash flows are expected to extend for a period **greater than one year**.

- Capital budgeting projects can be classified as:
  - **Replacement projects:** replacing old or worn-out equipment with new, more efficient equipment;
  - **Expansion projects:** increase the scale of ongoing projects;
  - Brand new products/services: introducing a new product/service (icebreakers);
  - **Regulatory/safety/environmental projects:** undertaken to comply with a requirement set by an external party, such as the government. Such projects may or may not generate revenue.
  - **Others:** pet projects or highly risky projects whose cash flows are highly uncertain.



# Describe the capital budgeting process and distinguish among the various categories of capital projects

## Steps in the capital budgeting process:

- **Step 1:** Generate/brainstorm ideas
- **Step 2:** Analyze the cash flows and profitability of each project
- **Step 3:** Plan the capital budget as guided by the timing of cash flows of the project (both inflows and outflows)
- **Step 4:** Continuously monitor the project and audit financial results to evaluate performance
- **Why is capital budgeting so important?**
  - It defines a company's strategic plan – assets acquired have long-term operational implications.
  - Long-term projects tie capital for at least a few years during which the company cannot use the funds to initiate other projects; it's imperative to get it right.



# Describe the basic principles of capital budgeting

Capital budgeting typically adopts the following principles:

- **Decisions are based on cash flows** and not on accounting concepts such as net income. Intangible costs and benefits are ignored.
- **The timing of cash flows is critical.**
- **Cash flows are based on opportunity costs.** A comparison is made between the incremental cash flows that occur with an investment and without the investment.
- **Cash flows are analyzed on an after-tax basis.** Taxes have to be fully reflected in capital budgeting decisions.
- **Financing costs are ignored.** Financing costs are already reflected in the required rate of return. Including them again in the cash flows would amount to double counting.
- **Capital budgeting cash flows are not the same as accounting net income.**



# Describe the capital budgeting process and distinguish among the various categories of capital projects

Key capital budgeting concepts:

- **Sunk costs:** already incurred costs
- **Opportunity cost:** value of the best forgone investment alternative
- **Externalities:** effects of a project on other things besides itself, e.g., impact on environment.
- **Conventional vs. Unconventional cash flow patterns**
  - Under a conventional pattern, an initial cash outflow is followed by a series of uninterrupted cash inflows
  - Under an unconventional pattern, cash flows can flip from positive to negative repeatedly throughout the term of the project
- **Incremental cash flow:** cash flow associated with a certain decision, i.e., cash flow with a decision minus cash flow without decision.



## Explain how the evaluation and selection of capital projects is affected by mutually exclusive projects, project sequencing, and capital rationing

- **Independent vs. Mutually exclusive projects**

Independent projects have independent cash flows. The outcome of one doesn't affect the outcome of the other. Mutually exclusive projects directly compete with each other. If A and B are mutually independent projects, pursuing A rules out going for B, and vice versa.

- Irrigation system for golf course

- **Project sequencing**

Investing in a beginner project paves way for future investment in other projects. The first project may provide the financial/infrastructural resources required for project 2, 3, 4, etc.

- Embedded options

- **Unlimited funds vs. Capital rationing**

Unlimited funds is the notion that a company can raise an unlimited amount of funds as and when it needs them, provided it's able to pay the required rate of return. Capital rationing exists when the company has to make do with limited funds and must therefore prioritize certain projects while dropping others.



# Major investment decision criteria

- Net Present Value – NPV
- Internal Rate of Return – IRR
- Modified Internal Rate of Return – MIRR
- Payback Period – Payback
- Discounted Payback Period – Discounted Payback
- Profitability Index – PI



**Calculate and interpret net present value (NPV), internal rate of return (IRR), payback period, discounted payback period, and profitability index (PI) of a single capital project.**

**1. Net Present Value:** Present value of cash flows minus initial investments

**Decision rule:** Invest in a project if and only if its NPV is positive.

***Example***

We can invest 100 EUR today and receive 120 EUR in one year. Given a 10% expected return, our increase in value is closest to:



**Calculate and interpret net present value (NPV), internal rate of return (IRR), payback period, discounted payback period, and profitability index (PI) of a single capital project.**

***Solution***

Increase in value = NPV of the investment.

$$NPV = -100 + 120/1.1 = 9.09 \text{ EUR}$$

Generally

$$NPV = -100 + \frac{120}{1.1} = 9.09 \text{ EUR}$$

Where  $CF_t$  is the cash flow at time  $t$ , and  $r$  is the expected return.

The NPV function syntax in MS Excel: NPV(rate,value1,[value2],...)

**Rate** – Required. The rate of discount over the length of one period.

**Value1,value2,...** – Value1 is required, subsequent values are optional.



**Calculate and interpret net present value (NPV), internal rate of return (IRR), payback period, discounted payback period, and profitability index (PI) of a single capital project.**

*Why is NPV the best decision criterion?*

- It considers the time value of money (TVM)... a euro today is worth more than a euro in the future.
- It considers all cash flows during the project's entire life.
- NPV lets you know exactly how much value is being added by the project.
- You can set the appropriate required rate of return (discount rate or hurdle rate) depending on a project's risk.



**Calculate and interpret net present value (NPV), internal rate of return (IRR), payback period, discounted payback period, and profitability index (PI) of a single capital project.**

**2. Internal Rate of Return (IRR):** Discount rate at which  $NPV = 0$ .

It's the discount rate that equates outflows to inflows.

**Decision rule:** Invest in a project if its IRR exceed the required rate of return, i.e., invest if  $IRR > r$ ; do not invest if  $IRR < r$ .

#### **Advantages**

- Considers time value of money
- Considers all cash flows
- Easy to understand

#### **Disadvantages**

- May use unreasonable discount rate
- Can conflict with NPV if projects are mutually exclusive



# Calculate and interpret net present value (NPV), internal rate of return (IRR), payback period, discounted payback period, and profitability index (PI) of a single capital project.

## Internal Rate of Return (IRR) : Problems

There are problems with using IRR rather than NPV when you are choosing between mutually exclusive projects:

- Independent projects: When evaluating multiple projects and any, none, or all of them can be accepted. Acceptance of any project has no bearing on the acceptance or rejection of another.
- Mutually exclusive projects: When evaluating multiple projects and only one can be accepted. Acceptance of one project means rejection of the other(s).

There is never a conflict between IRR and NPV criterion when evaluating independent projects. But when choosing between mutually exclusive projects, the IRR choice may conflict with the NPV choice under certain conditions. It's the discount rate that equates outflows to inflows.

**The Scale Problem:** A potential conflict exists when there are significant differences in the size of the cash flows. An example would be if comparing a project with a \$100,000 initial investment (COF) with another project with a \$1,000,000 initial investment.

**The Timing Problem:** A potential conflict exists when the timing of the cash flows for two projects are radically different. This can result in a conflict between the NPV choice and the IRR choice at low discount rates.

**Multiple IRRs:** Projects with non-normal (non-conventional) cash flows may have multiple IRRs. A normal (or conventional) cash flow is a cash outflow at the beginning of a project, followed by cash inflows thereafter.



# Calculate and interpret net present value (NPV), internal rate of return (IRR), payback period, discounted payback period, and profitability index (PI) of a single capital project.

## Example

Suppose we can invest 100 EUR today and receive 120 EUR in one year. The internal rate of return on our investment is *closest* to:

## Solution

$$-100 + \frac{120}{(1 + IRR)^1} = 0$$

$$\frac{120}{(1 + IRR)^1} = 100; IRR = 1.20 - 1 = 0.2 \text{ or } 20\%$$

The general form of the IRR equation is:

$$\sum_{t=0}^n \frac{CF_t}{(1+IRR)^t} = 0$$

The IRR function syntax in MS Excel: IRR(values, [guess])

**Values** – Required. An array or a reference to cells that contain numbers for which you want to calculate the internal rate of return.

**Guess** – Optional. A number that you guess is close to the result of IRR.



## Calculate and interpret net present value (NPV), internal rate of return (IRR), payback period, discounted payback period, and profitability index (PI) of a single capital project.

A farm producer hires a plumber to install an irrigation system. Initial cost is 250,000 EUR and the owner (producer) estimates the following cash flows:

Year 1 58,000 EUR, Year 2 59,000 EUR, Year 3 64,000 EUR, Year 4 68,000 EUR, and Year 5 71,000 EUR.

- Using a required rate of return of 8.1%, the NPV and IRR can be computed as:
- NPV = 2,703.53 EUR
- IRR = 8.49%
- CF(0) = -250,000; CF(1) = 58,000; CF(2) = 59,000; CF(3) = 64,000; CF(4) = 68,000; CF(5) = 71,000;
- Solve for NPV and IRR



**Calculate and interpret net present value (NPV), internal rate of return (IRR), payback period, discounted payback period, and profitability index (PI) of a single capital project.**

**3. Modified Internal Rate of Return (IRR):** Discount rate at which NPV = 0.

It's the discount rate that equates outflows to inflows.

**Decision rule:** Accept the project if MIRR > requested rate of return (discount rate). Reject the project if MIRR < requested rate of return (discount rate).

#### **Advantages**

- Let's you decide the reinvestment rate!

$$\text{Cost} = \frac{\text{Terminal Value}_T}{(1 + \text{MIRR})^T}$$

Given: costs, time value

Solve: MIRR



# Calculate and interpret net present value (NPV), internal rate of return (IRR), payback period, discounted payback period, and profitability index (PI) of a single capital project.

**4. Payback Period:** Time until cash flows recover the initial cost of investment of the project.

It ignores:

- The time value of money; and
- Cash flows beyond the payback period.

**Decision rule:** Accept if payback period < maximum acceptable payback period. Reject if payback period > maximum acceptable payback period.

## **Advantages**

- Easy to understand: the shorter the payback period, the better
- Quick indicator of the liquidity risk of the project (how long funds will be tied up)

## **Disadvantages**

- Ignores time value of money
- Ignores cash flows beyond acceptable payback date
- Acceptable payback date is usually an arbitrary cutoff point. Risk is not quantified in a required rate of return. The liquidity risk is simply a “rule of thumb”



# Calculate and interpret net present value (NPV), internal rate of return (IRR), payback period, discounted payback period, and profitability index (PI) of a single capital project.

**5. Discounted Payback Period:** Time period required for a project to generate enough *discounted* cash inflows to recover the initial cost.

It ignores:

- Cash flows beyond the payback period.

**Decision rule:** Accept if discounted payback period < maximum acceptable payback period. Reject if discounted payback period > maximum acceptable payback period.

## Advantages

- Easy to understand: the shorter the payback period, the better
- Quick indicator of the *liquidity risk* of the project (how long funds will be tied up)
- Does consider the time value of money

## Disadvantages

- Ignores cash flows beyond acceptable payback date
- Acceptable payback date is usually an arbitrary cutoff point.



**Calculate and interpret net present value (NPV), internal rate of return (IRR), payback period, discounted payback period, and profitability index (PI) of a single capital project.**

**6. Profitability Index:** Present value of a project's future cash flows divided by the initial investment.

$$PI = \frac{PV \text{ of future cash flows}}{Initial \text{ investment}} = 1 + \frac{NPV}{Initial \text{ investment}}$$

**Decision rule:** Accept the project if  $PI > 1.0$ . Reject the project if  $PI < 1.0$ .

#### **Advantages**

- Considers time value of money
- Considers all cash flows
- Uses reasonable discount rate
- Useful when faced with capital rationing

#### **Disadvantages**

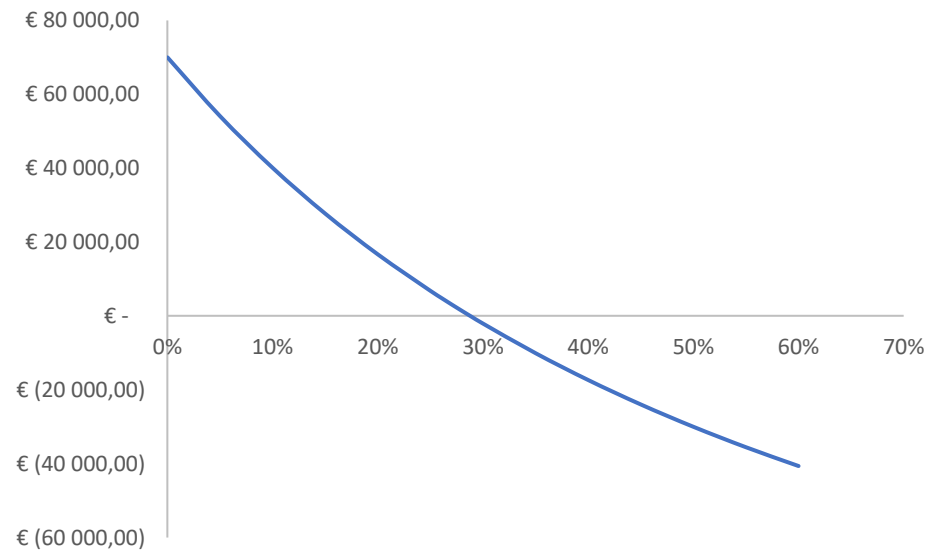
- Cannot distinguish projects of vastly different scale
- May conflict with NPV when evaluating mutually exclusive projects



## Explain the NPV profile, compare the NPV and IRR methods when evaluating independent and mutually exclusive projects, and describe the problems associated with each...

The NPV profile of a capital project graphically represents the project's NPV as a function of different discount rates.

For each discount rate, we could compute the NPV of a project. Graphing each of those NPV values against the discount rate would generate a downward sloping curve.





# Explain the NPV profile, compare the NPV and IRR methods when evaluating independent and mutually exclusive projects, and describe the problems associated with each...

## NPV vs. IRR

- For **independent projects**, both methods will lead to the same conclusion as to whether to invest or not.
- Whenever there is a conflict between NPV and IRR while evaluating **mutually exclusive projects**, you should **always** use the NPV.
- NPV assumes funds are reinvested at  $r$ , the required rate of return. IRR assumes funds are reinvested at the IRR. Reinvesting at  $r$  is **practically more realistic**, so NPV is generally better than IRR.

## Multiple IRR vs. No IRR Problem

- Sometimes a project may have multiple IRR values, especially if cash flows alternate between positive and negative throughout the term of the project.
- Some projects can also have a zero IRR.



## **Describe expected relations among an investment's NPV, company value, and share price**

In theory, a project with a positive NPV would be expected to increase company value by the amount of the NPV. Similarly, the share price would be expected to increase by the amount of NPV per share.

In practice, however, the effect of a project on both company value and share price hinges on the expectations among investors. For example, a company's project may have a positive NPV, but if the project's profitability falls short of the expectations among analysts and the investing community, then the company's stock price might fall.



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